Appendix A-1

Changes to the Wood and Edwards 2001 MTMVF terrestrial report January 2002

Habitat and songbird data were reanalyzed and sections of the original report (Wood and Edwards 2001) were modified as follows:

habitat data -- stem densities were recalculated and density of snags was added to the tables and analyses

Table 6. Means and standard errors for stem densities were corrected and snag densities added.

Tables 7-9. The new ANOVA statistics for stem densities and snags are reported.

Changes were also made to the text under the Results and Discussion section for the habitat measurements.

songbirds -- after we modified the stem density values and added snag data, we re-analyzed songbird habitat preferences using stepwise logistic regression rather than forward logistic regression. Changes were made to the text in the Methods, Results and Discussion sections and to Tables 16-20. These sections are attached below and should replace the sections and tables in the original report. Changes in the logistic regression results for individual species are briefly summarized here:

<u>Cerulean Warbler</u>
Previously they were related to elevation and canopy cover >6-12m (both positive relationships), but stepwise logistic regression chose no variables for predicting Cerulean Warbler presence.

<u>Louisiana Waterthrush</u>
The only variable chosen by stepwise logistic regression for predicting Louisiana Waterthrush was density of trees <2.5 cm (negative) (forward logistic regression chose bareground cover, moss cover, and density of trees >2.5-8cm).

<u>Worm-eating Warbler</u>
Forward logistic regression chose 5 variables to predict this species' presence. Stepwise logistic regression chose 1 variable: aspect code (negative relationship).

<u>Kentucky Warbler</u>
In the new model Kentucky Warblers are related to elevation and density of stems >8-23 cm (both negative), and green ground cover (positive).

<u>Wood Thrush</u>
In the forward model Wood Thrush were related to elevation (negative) and density of stems >23-38 cm (positive). The stepwise model chose both of these variables with the addition of canopy cover >24 m (positive).

<u>Acadian Flycatcher</u>
The forward model chose 7 variables for inclusion in the model. In the stepwise model, Acadian Flycatchers were negatively related to litter cover, and density of stems <2.5 cm and >8-23cm. They were positively related to bareground/rock cover.

<u>Hooded Warbler</u>

In the forward model they were positively related to woody debris and density of stems >2.5-8 cm. Stepwise logistic regression found green cover and density of stems <2.5 cm to be positively related to Hooded Warbler presence.

Yellow-throated Vireo
Seven variables were included in the forward model for this species, whereas the stepwise model did not choose any.

Black-and-white Warbler
The forward model included 6 variables, whereas the stepwise model included only water cover (negative).

Scarlet Tanager.
Six variables were included in the forward model, whereas only 3 were in the stepwise model (elevation, distance to mine, and density of stems >8-23 cm – all positive).

Yellow-billed Cuckoo
Forward logistic regression included woody debris cover (positive), and elevation and aspect (both negative) in the model. The stepwise model only included elevation.

Modified Text:

Methods

Songbird Abundance

Partners in Flight (PIF) identified 15 songbird species as priority species for conservation in the upland forest community of the Ohio Hills and Northern Cumberland Plateau physiographic areas, the 2 areas within which our study sites fall (Table 5; Rosenberg 2000, R. McClain, personal communication). The Cerulean Warbler in particular is listed as being at Action level II (in need of immediate management or policy rangewide) by PIF. The Louisiana Waterthrush and Eastern Wood-pewee are other species of concern, listed at Action level III (management needed to reverse or stabilize populations). The other 12 species are at Action level IV (long-term planning to ensure stable populations needed). We developed logistic regression models for the 11 listed species (Cerulean Warbler, Louisiana Waterthrush, Worm-eating Warbler, Kentucky Warbler,Acadian Flycatcher, Wood Thrush, Yellow-throated Vireo, Hooded Warbler, Scarlet Tanager, Black-and-white Warbler, and Yellow-billed Cuckoo) that were found at >5% of point counts (Table 5).

We used stepwise logistic regression (Neter et al. 1996) to examine the relationship between habitat characteristics and the presence/absence of these 11 forest songbirds using habitat data from fragmented and intact forest point counts. The significance level chosen for entry and retention in the model was 0.10. We used presence/absence as the dependent variable because at most point counts only 1 individual of a species was detected within 50 m (Hagan et al. 1997). This technique was chosen because it has been used by other researchers examining the effects of landscapes on songbird species (Hagan et al. 1997, Villard et al. 1999), and because predictor variables do not need to follow a joint multivariate normal distribution (Neter et al. 1996). The Hosmer and Lemeshow goodness-of-fit test was used to determine if the data fit the specified model. Models were rejected if the p-value for the goodness-of-fit test was <0.10, indicating that we should not reject the null hypothesis that our data fit the specified model (Cody and Smith 1997).

Results and Discussion

Habitat at Sampling Points

Habitat variables were measured at all sampling points in 1999 and 2000 (Table 6). Nineteen variables were measured in all treatments. Means for all habitat variables by treatment and mine are found in Appendix 4

Stem densities of saplings, poles, and trees in 5 size classes all differed significantly among treatments (Table 7). Densities of trees >8-23 cm were higher in fragmented and intact forest than in the grassland and shrub/pole treatments and also higher in the shrub/pole treatment than in the grassland treatment. Density of trees >53-68 cm and >68cm were greater in fragmented forest and intact forest than in grassland and shrub/pole treatments. Statistical analysis revealed treatment by mine interactions for saplings, poles, snags, and trees >23-38cm and trees >38-53 cm (Table 7); therefore treatments were compared on individual mines, and mines were compared in individual treatments. Specific ANOVA results for all variables exhibiting interactions are found in Tables 8 and 9.

Ground cover variables differed significantly among treatments. Although water cover was highest in the fragmented forest treatment than in the other 3 treatments and higher in the intact forest treatment than in the grassland or shrub/pole treatment (Table 7), cover of standing water averaged <1.2%. Moss cover was higher in fragmented and intact forest than in the grassland and shrub/pole treatments. Green cover was higher in the shrub/pole treatment than in the other 3 treatments, and higher in the grassland treatment than in the fragmented forest or intact forest treatments (Table 7). Bareground cover, litter cover, and woody debris cover had significant treatment by mine interactions (Tables 8 and 9).

Slope, aspect code, elevation, and distances to nearest minor, habitat, and mine/forest edges also were compared among all 4 treatments (Table 7). Distance to nearest minor edge was greater in the grassland treatment than in the other 3 treatments (Tables 6-7). There were significant mine x treatment interactions for slope, aspect code, elevation, distance to closest habitat edge, and distance to nearest mine/forest edge. The differences among treatments and mines for these variables are found in Tables 8-9.

Six variables were compared between grassland and shrub/pole treatments and mines. Litter depth was higher on the Hobet mine than the Cannelton and Daltex mines and higher in the Daltex mine than the Cannelton mine (Table 7). The Robel pole index was higher on the Cannelton mine than the other two mines and higher on the Daltex mine than the Hobet mine (Table 7). Forb cover was higher on the Cannelton and Daltex mines than on the Hobet mine (Table 7). The other variables all showed significant treatment by mine interactions. Grass height was higher at the Hobet mine than at the Daltex and Cannelton mines in the grassland treatment and higher at the Hobet mine than the Cannelton mine in the shrub/pole treatment (Table 9). Ground cover of grass and shrubs differed among mines, but not between grassland and shrub/pole treatments (Table 8-9).

Canopy height, percent canopy cover in 6 layer classes, and the structural diversity index were compared among the fragmented forest, intact forest, and shrub/pole treatments (Table 7). Percent canopy cover in 5 layer classes differed among treatments but not among mines (Table 7). There were treatment by mine interactions for canopy height and cover from >3-6 m. Canopy height was higher at the Cannelton mine than the Daltex and Hobet mines in the fragmented forest treatment, and was higher at the Daltex mine than the Hobet mine in the intact treatment (Table 8). Canopy cover from >3-6 m was higher at the Cannelton and Daltex mines than the Hobet mine in the intact forest treatment (Table 8). This cover layer also differed among treatments at the Cannelton and Hobet mines (Table 9). It was higher in the fragmented and intact forest treatments than the

shrub/pole treatment at the Cannelton mine. At the Hobet mine it was highest in the intact forest, followed by fragmented forest and shrub/pole treatments (Table 9).

Species-specific Logistic Regression Models

The presence/absence of 11 forest-dwelling songbird species of conservation priority for the region were related to specific habitat variables. Logistic regression models were fit for each species and none were rejected due to lack-of-fit (Hosmer and Lemeshow goodness-of-fit tests, P>0.10),

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Cerulean Warbler

The Cerulean Warbler, with the highest conservation priority rating (Table 5), was not found to be related to any of the microhabitat variables we measured (Table 16). The Ohio Hills and Northern Cumberland Plateau physiographic provinces where MTMVF mining is prominent are within the core area for the Cerulean Warbler. It is estimated that 46.8% of this species' population is found within the Ohio Hills province alone (Rosenburg 2000). This species prefers large tracts of mature forests with large, tall trees (P. Hamel, unpub. rept.). Based on previous knowledge of habitat preferences, it is reasonable to conclude that continued MTMVF mining will negatively impact Cerulean Warbler abundance in southwestern West Virginia.

Lousiana Waterthrush

The Lousiana Waterthrush, with the second highest conservation rating, was negatively related to sapling density (Table 16). This species is found in large tracts of mature forest and nests on the ground along stream banks (Whitcomb et al. 1981, Ehrlich et al. 1988). Bushman and Therres (1988) suggested that wooded streambanks and ravines be protected in order to maintain this species. Given valleys and streams are covered by MTMVF operations and reduces mature forest cover, it is logical to conclude that this species also will be negatively affected by loss of streamside forest habitat from this type of mining.

Worm-eating Warbler

This species was negatively related to aspect code (Table 17). Worm-eating Warblers typically are found on dry ravines and hillsides in deciduous woods where they nest on the ground in leaf litter (Ehrlich et al. 1988, Dettmers and Bart 1999). They are most abundant in mature forests, although they may be found in young- and medium-aged forest stands as well (Bushman and Therres 1988). Robbins (1980) and Whitcomb et al. (1981) suggested that this species requires large tracts of mature forest and may have a low tolerance for fragmentation. The greatest threat to this species from MTMVF is the loss and fragmentation of forested habitat.

Kentucky Warbler

Kentucky Warblers were present at points with a high percent of green ground cover and a low density of trees from >8-23cm and also were present more often at lower elevations (Table 17). Kentucky Warblers prefer rich, moist forests and bottomlands with well-developed ground cover (Bushman and Therres 1984). This species appears to be moderately affected by fragmentation and may be found in small woodlots, but in Maryland the highest frequency of occurrence for this species was in forests from 130-700 ha in size (Bushman and Therres 1988). Loss of wooded ravines and bottomlands could negatively affect this species.

Acadian Flycatcher

This species was one of our most abundant birds and abundance was correlated to several habitat variables (Table 18). It was negatively related to density of saplings and trees >8-23 cm dbh,

indicating an association with mature forests. It also was negatively associated with leaf litter cover. Acadian Flycatchers prefer moist ravines and stream bottoms. Dettmers and Bart (1999) considered this species to be a habitat "specialist" at the microhabitat (i.e. territory or home range) level. Bushman and Therres (1988) found that Acadian flycatchers prefer forests with high canopy cover, large trees, and an open understory. This species prefers large blocks of mature contiguous forest for breeding, and appears to avoid edges. We found this species to be more abundant in intact forest, which could indicate that MTMVF mining is detrimental to this species.

Wood Thrush

Wood Thrush were positively related to density of trees >23-38 cm dbh and canopy cover >24m and negatively associated with elevation (Table 18). Wood Thrush are found in deciduous and mixed coniferous-deciduous forest, with highest densities occurring in the Appalachian Mountain region (James et al. 1984). They prefer mature forests with some small trees in the understory for nesting and a moist, leafy litter layer for foraging (James et al. 1984).

Yellow-throated Vireo

Presence of this species was not related to any microhabitat variables. It is most abundant in mature forests and appears to prefer stream borders and bottomland forests (Bushman and Therres 1988). Yellow-throated Vireos appear to have a low tolerance for forest fragmentation (Whitcomb et al. 1981). MTMVF mining could potentially reduce abundance of in this species because of its preference for mature forest along streams, which may be lost due to mining.

Hooded Warbler

Hooded Warblers were positively related to percent green ground cover and sapling density (Table 19). Hooded Warblers typically are found in moist deciduous forests and ravines with a well-developed understory (Ehrlich et al. 1988), but also may be found along ridges with a high density of shrub stems (Dettmers and Bart 1999). It is suspected that this species is fragmentation-sensitive (Bushman and Therres 1988), and we found it to occur at higher abundances in intact than fragmented forest sites.

Scarlet Tanager

This species was positively associated with percent slope, density of trees from >38-53 cm, and distance to mine edge (Table 20). This species may be found in a wide range of successional stages of forests, but is most abundant in mature woods with a dense canopy (Bushman and Therres 1988). This species does not appear to be as fragmentation-sensitive as other forest interior species, and may tolerate smaller forests and edges (Bushman and Therres 1988); however, it was more abundant in our intact than fragmented forest sites during 1 year of the study, and was more common at points further away from mine/forest edge.

Black-and-white Warbler

Black-and-white Warblers were negatively associated with percent water cover. This species nests on the ground in deciduous and mixed forests (Ehrlich et al. 1988). It appears to prefer pole-stage stands (Bushman and Therres 1988), but it is fragmentation-sensitive and was not found breeding in forests <70 ha in size in Maryland (Whitcomb et al. 1981).

Yellow-billed Cuckoo

The Yellow-billed Cuckoo was negatively associated with elevation (X^2=6.46, P=0.01). This species is a PIF priority species for the region (Rosenberg 2000), but we observed it at only 9 sampling points in the 2 years of the study. Less than 1% of the population occurs in this region (Rosenberg and Wells 1999), and MTMVF is not likely to severely impact the population as a whole.

Other Species

The Swainson's Warbler, a species of concern in the region and a rare species in West Virginia (West Virginia Wildlife and Natural Heritage Program 2000), is typically, in West Virginia, found only in areas of dense rhododendron (Buckelew and Hall 1994). We observed this species in the Twentymile Creek watershed along Hughes Fork. Further MTMVF in this watershed could impact this species, but the effect on the population as a whole will be minimal, since <2% of the population is found in the Ohio Hills province and West Virginia is on the periphery of its range (Table 5) . The Eastern Wood-pewee is a species of conservation priority (Action level III) in the region, but we only observed it at 1.2% of our forested point counts. The Black-billed Cuckoo is a PIF priority species for this region (Rosenberg 2000), but it appears to be relatively rare; it was only observed incidentally in early successional habitat during this study and was not detected during point count surveys.

Table 6. Mean and standard error (SE) for habitat variables measured at grassland (n=44), shrub/pole (n=33), fragmented forest (n=36), and intact forest (n=49) sampling points.

	Treatment							
	Grassland		Shrub/Pole		Fragmented Forest		Intact Forest	
Variables	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Slope (%)	16.96	2.10	10.16	1.93	33.78	2.28	33.75	2.07
Aspect Code	1.05	0.10	0.78	0.13	1.05	0.12	1.02	0.08
Grass/Forb Height (dm)	7.29	0.27	6.20	0.48	--[a]	--	--	--
Litter Depth (cm)	2.26	0.19	1.64	0.17	--	--	--	--
Elevation (m)	400.93	7.19	378.85	11.53	332.08	7.11	389.58	10.87
Distance to Minor Edge (m)	113.02	16.75	68.14	8.23	38.71	3.88	64.61	11.57
Distance to Habitat Edge (m)	335.46	45.26	79.16	11.06	128.61	12.52	1430.66	145.32
Distance to Forest/Mine Edge (m)	347.35	44.30	253.98	34.46	128.61	12.52	1430.66	145.32
Robel Pole Index	2.93	0.17	4.30	0.27	--	--	--	--
Canopy Height (m)	--	--	4.67	0.45	21.70	0.72	22.90	0.67
Ground Cover (%)								
Water	0.14	0.10	0.15	0.12	1.15	0.32	0.48	0.17
Bareground	7.73	1.18	2.22	0.92	7.71	0.95	7.45	0.59
Litter	8.14	1.54	6.06	1.78	54.24	1.88	48.32	1.75
Woody Debris	0.06	0.04	0.30	0.12	4.20	0.42	4.95	0.41
Moss	1.04	0.38	1.83	0.86	2.01	0.32	2.04	0.34
Green	82.78	2.00	85.86	3.47	30.35	1.74	36.61	1.99
Forb Cover	23.63	2.39	21.89	2.86	--	--	--	--
Grass Cover	45.05	2.71	43.70	5.26	--	--	--	--
Shrub Cover	14.13	2.72	22.99	3.23	--	--	--	--
Stem Densities (no./ha)								
<2.5 cm	777.70	207.52	7475.38	1646.08	4935.76	450.55	6135.84	702.59
>2.5-6 cm	73.15	18.79	979.17	292.52	901.04	65.86	587.37	55.71
>8-23 cm	0.03	0.02	126.89	22.66	339.76	34.12	262.12	11.43
>23-38 cm	0.00	0.00	5.68	2.02	89.41	5.20	90.82	4.82
>38-53 cm	0.00	0.00	0.00	0.00	30.38	3.22	31.12	2.55
>53-68 cm	0.00	0.00	0.00	0.00	9.90	1.71	8.04	1.18
>68 cm	0.00	0.00	0.00	0.00	3.99	0.87	3.19	0.71
Snags >2.5 cm	0.00	0.00	14.03	4.88	41.87	3.99	48.55	6.37
Canopy Cover (%)								
>0.5-3 m	--	--	29.70	2.94	54.90	2.33	47.63	2.33
>3-6 m	--	--	22.88	2.86	66.63	2.42	54.67	2.06
>6-12 m	--	--	14.37	2.59	63.06	2.38	65.46	1.24
>12-18 m	--	--	2.84	0.86	56.01	2.68	63.34	2.07
>18-24 m	--	--	0.11	0.08	41.39	2.97	51.28	3.06
>24 m	--	--	0.00	0.00	16.15	2.48	18.06	2.14
Structural Diversity Index	--	--	13.98	1.47	59.63	1.29	60.09	1.39

[a] Variables were not measured in this treatment.

Table 7. Two-way ANOVA results comparing habitat variables among treatments and mines.

	Factor Levels														
	Treatment			Waller-Duncan[a]				Mine			Waller-Duncan[b]			Treatment x Mine		
Variables	F	df	P	GR	SH	FR	IN	F	df	P	Can.	Dal.	Hob.	F	df	P
Slope (%)	39.79	3	<0.01	B	C	A	A	26.55	2	<0.01	B	A	A	5.26	5	<0.01
Aspect Code	2.27	3	0.08					0.04	2	0.96				1.81	5	0.11
Elevation (m)	24.94	3	<0.01	A	B	C	A	106.18	2	<0.01	A	B	C	4.63	5	<0.01
Grass Height (dm)	3.82	1	0.06					20.78	2	<0.01	C	B	A	4.26	1	0.04
Litter Depth (cm)	3.56	1	0.06					25.07	2	<0.01	C	B	A	2.31	1	0.13
Distance to minor edge (m)	4.69	3	<0.01	A	B	B	B	0.35	2	0.70				2.08	5	0.07
Distance to habitat edge (m)	708.60	3	<0.01	B	C	C	A	188.61	2	<0.01	B	A	C	189.17	5	<0.01
Distance to mine/forest edge (m)	577.33	3	<0.01	B	B	C	A	142.21	2	<0.01	B	A	C	172.35.	5	<0.01
Robel Pole Index	20.66	1	<0.01					11.09	2	<0.01	B	A	C	0.00	1	0.94
Canopy Height (m)	222.33	2	<0.01	--	B	A	A	1.02	2	0.36				7.66	3	<0.01
Ground Cover (%):																
Water	4.19	3	<0.01	B	B	A	B	0.25	2	0.78				1.48	5	0.20
Bareground	13.19	3	<0.01	A	B	A	A	0.11	2	0.89				4.71	5	<0.01
Litter	230.03	3	<0.01	C	C	A	B	0.31	2	0.73				10.06	5	<0.01
Woody Debris	144.45	3	<0.01	B	B	A	A	0.88	2	0.42				2.77	5	0.02
Moss	5.48	3	<0.01	B	B	A	A	0.02	2	0.98				1.04	5	0.40
Green	130.34	3	<0.01	B	A	C	C	0.92	2	0.40				1.79	5	0.12
Forb	0.11	1	0.74					5.02	2	0.01	A	A	B	3.96	1	0.05
Grass	1.47	1	0.23					24.22	2	<0.01	C	B	A	5.25	1	0.02
Shrub	3.95	1	0.05					15.65	2	<0.01	A	B	B	4.68	1	0.03
Stem Density (no./ha):																
<2.5 cm	67.03	3	<0.01	B	A	A	A	2.86	2	0.06				5.71	5	<0.01
>2.5-8 cm	79.55	3	<0.01	C	AB	A	B	1.28	2	0.28				2.43	5	0.04
>8-23 cm	484.80	3	<0.01	C	B	A	A	2.99	2	0.06				0.95	5	0.45
>23-38 cm	495.00	3	<0.01	C	B	A	A	1.24	2	0.29	B	A	B	3.70	5	<0.01
>38-53 cm	420.46	3	<0.01	B	B	A	A	0.03	2	0.97				3.83	5	<0.01
>53-68 cm	38.74	3	<0.01	B	B	A	A	0.66	2	0.52				1.43	5	0.22
>68 cm	11.95	3	<0.01	B	B	A	A	2.80	2	0.06				1.83	5	0.11
Snags	43.86	3	<0.01	C	B	A	A	0.60	2	0.55				3.69	5	0.01

Table 7. Continued.

	Factor Levels														
	Treatment			Waller-Duncan[a]				Mine			Waller-Duncan[b]			Treatment x Mine		
Variables	F	df	P	GR	SH	FR	IN	F	df	P	Can.	Dal.	Hob.	F	df	P
Canopy Cover (%):																
0.5-3 m	25.16	2	<0.01	--	C	A	B	0.70	2	0.50				0.98	3	0.40
>3-6 m	75.63	2	<0.01	--	C	A	B	0.18	2	0.84				3.40	3	0.02
>6-12 m	148.67	2	<0.01	--	B	A	A	1.57	2	0.21				3.74	3	0.01
>12-18 m	280.81	2	<0.01	--	C	B	A	1.60	2	0.21				2.59	3	0.06
>18-24 m	180.95	2	<0.01	--	C	B	A	4.83	2	<0.01	B	A	B	2.92	3	0.04
>24 m	36.62	2	<0.01	--	B	A	A	0.28	2	0.76				2.67	3	0.05
Structural Diversity Index	339.75	2	<0.01	--	B	A	A	1.75	2	0.18	B	A	B	6.09	3	<0.01

[a] Waller-Duncan k-ratio t-test. Treatments with different letters differ at P<0.05 ('A' indicates highest value). GR=grassland; SH=shrub/pole; FR=fragmented forest; IN=intact forest.
[b] Waller-Duncan k-ratio t-test. Mines with different letters differ at P<0.05 ('A' indicates highest value). Can.=Cannelton; Dal.=Daltex; Hob.=Hobet.

Table 8. ANOVA results comparing habitat variables among mines within individual treatments for variables with treatment x mine interactions.

	Treatment/Mine																					
	Grassland			Waller-Duncan[a]			Shrub/pole			Waller-Duncan		Fragmented Forest			Waller-Duncan			Intact Forest			Waller-Duncan		
Variables	F	df	P	Can.	Dal.	Hob.	F	df	P	Can.	Hob.	F	df	P	Can.	Dal.	Hob.	F	df	P	Can.	Dal.	Hob.
Slope (%)	2.30	2	0.11	B	A	AB	120.21	1	<0.01	B	A	6.40	2	<0.01	B	A	A	4.72	2	0.01	B	B	A
Elevation (m)	19.53	2	<0.01	A	A	B	127.50	1	<0.01			14.40	2	<0.01	A	B	C	37.36	2	<0.01	A	B	C
Distance to minor edge (m)	1.09	2	0.35				0.80	1	0.38			1.39	2	0.26				2.88	2	0.07	B	A	B
Distance to habitat edge (m)	11.77	2	<0.01	B	A	B	3.40	1	0.07	A	B	3.60	2	0.04	AB	B	A	426.79	2	<0.01	A	A	B
Distance to forest/mine edge (m)	10.00	2	<0.01	B	A	B	11.33	1	<0.01	B	A	3.60	2	0.04	AB	B	A	426.79	2	<0.01	A	A	B
Grass Height (dm)	5.42	2	<0.01	B	AB	A	31.76	1	<0.01	B	A	--	--	--				--	--	--			
Canopy Height (m)	--	--	--				1.22	1	0.28			7.34	2	<0.01	A	B	A	3.17	2	0.05	AB	A	B
Ground Cover (%):																							
Bareground	3.75	2	0.03	AB	A	B	0.77	1	0.39			6..94	2	<0.01	B	B	A	0.80	2	0..46			
Litter	12.35	2	<0.01	C	B	A	22.97	1	<0.01	A	B	4.28	2	002	A	AB	B	4.07	2	0.02	A	B	B
Woody debris												0.76	2	0.47				4.11	2	0.02	A	B	AB
Grass	10.77	2	<0.01	B	B	A	27.34	1	<0.01	B	A	--	--	--				--	--	--			
Forb	1.22	2	0.31				10.87	1	<0.01	A	B	--	--	--				--	--	--			
Shrub	12.95	2	<0.01	A	B	C	7.15	1	0.01	A	B	--	--	--				--	--	--			
Stem Density (no./ha):																							
<2.5cm	5.81	2	<0.01	B	A	A	0.00	1	0.98			0.74	2	0.49				0.55	2	0.58			
>2.5-8 cm	--	--	--									3.26	2	0.05	AB	A	B	0.78	2	0.46			
>23-38cm	--	--	--				3.47	1	0.07	A	B	1.25	2	0.30				0.37	2	0.69			
>38-53cm	--	--	--									8.75	2	<0.01	B	A	A	5.37	2	<0.01	B	A	A
Snags	--	--	--															1.41	2	0.25			
Canopy Cover (%):																							
>3-6m	--	--	--				2.63	1	0.12			1.76	2	0.19				3.27	2	0.05	A	B	AB
>6-12m	--	--	--				1.95	1	0.17			4.26	2	0.02	B	A	B	3.42	2	0.04	A	B	B
>12-18m	--	--	--				2.07	1	0.16			2.57	2	0.09				1.64	2	0.21			
>18-24m	--	--	--				0.04	1	0.84			0.73	2	0.49				5.30	2	0.01	A	B	B
>24m	--	--	--				--	--	--			0.66	2	0.52				2.53	2	0.10			
Structural Diversity Index	--	--	--				1.18	1	0.28			1.98	2	0.15				7.85	2	<0.01	A	B	B

[a] Waller-Duncan k-ratio t-test. Mines with different letters differ at P<0.05 ('A' indicates highest value). Can.=Cannelton; Dal.= Daltex; Hob.=Hobet.

Table 9. ANOVA results comparing habitat variables among treatments at individual mines for variables with treatment x mine interactions.

	Mine/treatment																		
	Cannelton			Waller-Duncan[a]				Daltex			Waller-Duncan			Hobet			Waller-Duncan			
Variables	F	df	P	GR	SH	FR	IN	F	df	P	GR	FR	IN	F	df	P	GR	SH	FR	IN
Slope (%)	39.47	3	<0.01	B	C	A	A	1.77	2	0.19				22.80	3	<0.01	B	B	A	A
Elevation (m)	11.28	3	<0.01	AB	B	C	A	9.18	2	<0.01	A	B	A	11.93	3	<0.01	A	BC	C	B
Distance to minor edge (m)	1.73	3	0.18					1.05	2	0.36				8.61	3	<0.01	A	B	B	B
Distance to habitat edge (m)	759.76	3	<0.01	B	B	B	A	213.54	2	<0.01	B	C	A	24.67	3	<0.01	B	C	B	A
Distance to forest/mine edge (m)	660.78	3	<0.01	B	B	B	A	213.54	2	<0.01	B	C	A	10.19	3	<0.01	B	D	C	A
Grass Height (dm)	4.25	1	0.05					--	--	--				0.01	1	0.91				
Canopy Height (m)	97.45	1	<0.01	--	B	A	A	25.97	1	<0.01				124.13	2	<0.01	--	B	A	A
Ground Cover (%):																				
Bareground	7.33	3	<0.01	A	B	A	A	1.58	2	0.22				8.94	3	<0.01	B	C	AB	A
Litter	97.60	3	<0.01	C	B	A	A	106.39	2	<0.01	C	A	B	86.51	3	<0.01	B	C	A	A
Woody debris	51.28	3	<0.01	C	C	B	A	42.68	2	<0.01	B	A	A	67.25	3	<0.01	C	C	B	A
Forb	1.42	1	0.24					--	--	--				3.07	1	0.09	B	A	--	--
Grass	4.45	1	0.05	A	B	--	--	--	--	--				0.73	1	0.40				
Shrub	0.02	1	0.89					--	--	--				13.16	1	<0.01	B	A	--	--
Stem Densities (no./ha):																				
<2.5cm	47.81	3	<0.01	B	A	A	A	21.94	2	<0.01	B	A	A	15.18	3	<0.01	B	A	A	A
>2.5-8	105.52	3	<0.01	C	B	A	AB	22.93	2	<0.01	B	A	A	23.25	3	<0.01	B	A	A	A
>23-38cm	61.04	3	<0.01	C	B	A	A	711.84	2	<0.01	B	A	A	422.26	3	<0.01	C	B	A	A
>38-53cm	312.17	3	<0.01	C	C	A	B	89.21	2	<0.01	B	A	A	238.71	3	<0.01	C	C	B	A
Snags	4.92	3	0.01	C	B	A	A	5.28	2	0.03	B	A	A	57.20	3	<0.01	C	B	A	A
Canopy Cover (%):																				
>3-6m	23.10	2	<0.01	--	B	A	A	22.26	1	<0.01				42.37	2	<0.01	--	B	A	A
>6-12m	54.35	2	<0.01	--	B	A	A	12.94	1	<0.01				69.97	2	<0.01	--	B	A	A
>12-18m	147.00	2	<0.01	--	B	A	A	1.39	1	0.25				113.82	2	<0.01	--	B	A	A
>18-24m	197.41	2	<0.01	--	C	B	A	4.08	1	0.06				59.06	2	<0.01	--	B	A	A
>24m	82.98	2	<0.01	--	C	B	A	0.49	1	0.49				12.56	2	<0.01	--	B	A	A

Table 9 continued

Structural Diversity Index	157.86	2	<0.01	--	C	B	A	10.64	1	<0.01		143.36	2	<0.01	--	B	A	A

[a] Waller-Duncan k-ratio t-test. Treatments with different letters differ at P<0.05 ('A' indicates highest value). GR=grassland; SH=shrub/pole; FR=fragmented forest; IN=intact forest.

Table 16. Means, standard errors (SE), and forward logistic regression results (Wald chi-square statistics) for the presence/absence of the Cerulean Warbler and Louisiana Waterthrush at point counts in forested habitats in southwestern West Virginia. The '-' and '+' indicate either a negative or a positive relationship between abundance and the habitat variables.

	Cerulean Warbler						Louisiana Waterthrush					
	Absent		Present				Absent		Present			
Variable	Mean	SE	Mean	SE	X^2	P	Mean	SE	Mean	SE	X^2	P
Aspect Code	0.98	0.08	1.17	0.13			1.03	0.08	1.15	0.16		
Slope (%)	31.75	2.02	37.28	2.15			33.08	1.71	37.21	3.74		
Elevation (m)	376.11	9.44	361.90	14.52			376.76	8.94	341.36	15.48		
Distance to mine (m)	979.76	146.84	916.64	194.49			994.39	128.28	765.79	282.99		
Distance to closest minor edge (m)	61.98	10.52	39.11	4.73			54.74	8.27	48.07	6.52		
Canopy Height (m)	21.70	0.62	22.62	0.79			22.04	0.53	22.04	1.88		
Ground Cover (%)												
Water	0.79	0.23	0.73	0.24			0.85	0.20	0.36	0.28		
Litter	49.88	1.73	52.46	2.00			49.98	1.50	55.09	2.29		
Bareground	7.89	0.68	6.98	0.81			7.66	0.62	7.05	0.65		
Woody Debris	4.63	0.39	4.64	0.46			4.58	0.33	4.91	0.70		
Green	34.24	1.83	33.47	2.15			34.45	1.59	31.43	2.57		
Moss	2.06	0.29	1.98	0.42			2.04	0.26	1.96	0.55		
Stem Densities (no./ha)												
<2.5 cm	5827.55	663.50	5279.23	440.98			5619.72	505.43	5667.41	986.35	4.92	0.03-
>2.5-8 cm	697.92	54.73	759.07	81.40			706.87	47.67	787.95	137.40		
>8-23 cm	291.20	20.02	301.61	28.41			292.43	18.40	308.04	34.26		
>23-38 cm	93.17	4.73	85.08	5.04			90.14	3.87	90.63	8.86		
>38-53 cm	28.94	2.40	34.07	3.50			30.19	2.19	33.93	4.93		
>53-68 cm	9.38	1.30	7.86	1.53			8.98	1.10	8.04	2.40		
>68 cm	3.36	0.63	3.83	1.03			3.43	0.61	4.02	1.24		
Snags >2.5cm	44.24	5.19	48.15	6.27			43.04	3.88	58.51	13.93		
Canopy Cover (%)												
0.5-3 m	49.42	2.07	52.94	2.99			50.35	1.85	52.50	4.49		
>3-6 m	60.63	2.05	58.19	2.96			59.00	1.74	63.48	5.19		
>6-12 m	64.86	1.27	63.71	2.58			64.35	1.43	64.91	1.84		
>12-18 m	59.05	2.13	62.30	2.75			60.23	1.91	60.27	3.43		
>18-24 m	46.04	2.92	48.91	3.37			47.92	2.35	42.86	6.39		
>24 m	16.13	2.05	19.19	2.62			18.06	1.83	13.13	3.11		
Structural Diversity Index	59.23	1.31	61.05	1.35			59.98	1.02	59.43	2.90		

Table 17. Means, standard errors (SE), and forward logistic regression results (Wald chi-square statistics) for the presence/absence of the Worm-eating Warbler and Kentucky Warbler at point counts in forested habitats in southwestern West Virginia. The '-' and '+' indicate either a negative or a positive relationship between abundance and the habitat variables.

	Worm-eating Warbler						Kentucky Warbler					
	Absent		Present				Absent		Present			
Variable	Mean	SE	Mean	SE	X^2	P	Mean	SE	Mean	SE	X^2	P
Aspect Code	1.14	0.08	0.73	0.10	5.76	0.02-	1.02	0.08	1.12	0.11		
Slope (%)	34.58	1.69	31.10	3.46			33.05	1.87	35.68	2.53		
Elevation (m)	374.57	8.97	359.10	17.53			383.23	9.51	337.78	12.44	8.30	<0.01-
Distance to mine (m)	996.20	137.73	828.48	215.34			1028.68	139.65	762.82	208.64		
Distance to closest minor edge (m)	54.66	8.02	50.31	14.49			53.11	8.25	55.07	13.37		
Canopy Height (m)	21.91	0.56	22.46	1.01			21.83	0.58	22.60	0.89		
Ground Cover (%)												
Water	0.73	0.20	0.88	0.35			0.71	0.19	0.92	0.36		
Litter	50.35	1.59	52.38	2.18			49.25	1.63	55.05	1.90		
Bareground	8.06	0.62	5.94	0.86			8.10	0.64	6.09	0.83		
Woody Debris	4.98	0.35	3.50	0.51			4.64	0.36	4.62	0.51		
Green	34.00	1.70	33.81	2.23			35.22	1.79	30.54	1.67	7.36	<0.01+
Moss	2.10	0.26	1.81	0.58			1.90	0.25	2.39	0.57		
Stem Densities (no./ha)												
<2.5 cm	5859.62	559.47	4873.44	584.25			5605.34	566.10	5687.50	680.87		
>2.5-8 cm	712.50	53.81	745.31	84.99			671.88	51.77	850.54	90.42		
>8-23 cm	279.81	17.82	344.38	36.79			270.26	15.48	361.68	41.04	5.28	0.02-
>23-38 cm	88.27	3.98	96.56	7.61			90.12	4.38	90.49	5.67		
>38-53 cm	31.35	2.36	29.06	3.66			29.74	2.22	33.70	4.34		
>53-68 cm	9.71	1.21	5.94	1.40			8.17	1.03	10.60	2.40		
>68 cm	3.75	0.65	2.81	0.96			3.43	0.59	3.80	1.29		
Snags >2.5 cm	42.88	4.79	54.39	6.73			40.23	4.20	59.81	8.89		
Canopy Cover (%)												
0.5-3 m	48.83	1.96	56.81	3.13			49.92	2.01	52.83	3.25		
>3-6 m	58.08	1.90	65.13	3.43			57.96	1.85	64.51	3.63		
>6-12 m	64.12	1.30	65.50	3.15			64.03	1.39	65.54	2.63		
>12-18 m	61.06	1.93	57.56	3.47			61.73	2.01	56.20	2.97		
>18-24 m	49.21	2.54	40.19	4.28			50.99	2.46	36.58	4.15		
>24 m	18.58	1.93	12.94	2.62			17.70	1.86	16.03	3.27		
Structural Diversity Index	59.97	1.14	59.63	1.85			60.47	1.12	58.34	1.92		

Table 18. Means, standard errors (SE), and forward logistic regression results (Wald chi-square statistics) for the presence/absence of the Wood Thrush and Acadian Flycatcher at point counts in forested habitats in southwestern West Virginia. The '-' and '+' indicate either a negative or a positive relationship between abundance and the habitat variables.

	Wood Thrush						Acadian Flycatcher					
	Absent		Present				Absent		Present			
Variable	Mean	SE	Mean	SE	X^2	P	Mean	SE	Mean	SE	X^2	P
Aspect Code	1.04	0.10	1.05	0.09			0.85	0.18	1.09	0.07		
Slope (%)	31.86	2.53	35.23	1.87			33.94	3.58	33.72	1.70		
Elevation (m)	387.24	9.89	358.35	11.67	4.92	0.03-	385.06	17.80	367.65	8.94		
Distance to mine (m)	1049.47	180.64	885.26	153.19			711.22	239.19	1013.67	132.67		
Distance to closest minor edge (m)	58.52	11.58	49.88	8.63			80.72	23.55	47.36	6.53		
Canopy Height (m)	22.10	0.70	21.99	0.68			20.93	1.07	22.30	0.54		
Ground Cover (%)												
Water	0.54	0.27	0.94	0.22			0.23	0.17	0.89	0.21		
Litter	47.09	2.23	53.70	1.47			46.48	3.54	51.83	1.39	4.62	0.03-
Bareground	7.33	0.89	7.73	0.63			7.89	1.42	7.48	0.56	5.80	0.02+
Woody Debris	4.39	0.41	4.82	0.42			4.22	0.57	4.73	0.34		
Green	38.07	2.44	30.78	1.47			39.77	3.85	32.61	1.44		
Moss	1.96	0.37	2.08	0.31			2.11	0.67	2.01	0.25		
Stem Densities (no./ha)												
<2.5 cm	5139.36	557.89	6003.91	671.25			6421.88	1442.45	5443.39	446.38	7.52	<0.01-
>2.5-8 cm	602.20	65.65	811.20	60.12			671.88	101.66	731.43	51.16		
>8-23 cm	268.24	22.68	315.63	22.75			278.52	32.69	298.82	18.68	4.51	<0.03-
>23-38 cm	87.84	5.76	92.06	4.43	5.81	0.02+	86.33	7.95	91.12	3.95		
>38-53 cm	34.63	2.90	27.86	2.68			38.28	4.70	29.08	2.17		
>53-68 cm	6.93	1.30	10.29	1.42			8.59	2.41	8.88	1.10		
>68 cm	3.72	0.82	3.39	0.74			5.08	1.30	3.17	0.60		
Snags >2.5 cm	46.20	7.19	45.24	4.49			39.46	6.96	47.13	4.67		
Canopy Cover (%)												
0.5-3 m	47.40	2.61	53.26	2.21			46.48	4.03	51.68	1.88		
>3-6 m	54.22	2.22	63.98	2.28			56.09	3.58	60.58	1.90		
>6-12 m	64.59	1.94	64.32	1.61			64.61	2.62	64.40	1.40		
>12-18 m	63.04	2.56	58.07	2.21			62.73	3.50	59.66	1.91		
>18-24 m	50.10	3.35	44.77	2.95			51.80	4.23	46.00	2.54		
>24 m	16.05	2.51	18.18	2.12	5.45	0.02+	20.47	3.89	16.50	1.77		
Structural Diversity Index	59.08	1.52	60.52	1.26			60.44	1.79	59.76	1.12		

Table 19. Means, standard errors (SE), and forward logistic regression results (Wald chi-square statistics) for the presence/absence of the Hooded Warbler and Yellow-throated Vireo at point counts in forested habitats in southwestern West Virginia. The '-' and '+' indicate either a negative or a positive relationship between abundance and the habitat variables.

	Hooded Warbler						Yellow-throated Vireo					
	Absent		Present				Absent		Present			
Variable	Mean	SE	Mean	SE	X^2	P	Mean	SE	Mean	SE	X^2	P
Aspect Code	1.00	0.09	1.13	0.11			1.03	0.07	1.11	0.19		
Slope (%)	33.04	2.09	34.91	2.17			32.98	1.77	36.91	2.80		
Elevation (m)	358.47	9.26	391.56	14.09			370.03	9.44	374.53	13.42		
Distance to mine (m)	780.70	136.97	1248.30	203.05			1040.72	134.30	620.81	213.49		
Distance to closest minor edge (m)	55.17	8.25	51.09	12.70			55.09	8.64	47.84	5.13		
Canopy Height (m)	21.25	0.67	23.28	0.63			22.40	0.56	20.59	0.88		
Ground Cover (%)												
Water	0.85	0.24	0.63	0.22			0.77	0.19	0.74	0.40		
Litter	49.67	1.70	52.73	2.07			49.87	1.53	54.63	2.27		
Bareground	7.78	0.69	7.19	0.81			7.63	0.56	7.28	1.44		
Woody Debris	4.79	0.35	4.38	0.53			4.83	0.34	3.82	0.59		
Green	34.83	1.85	32.50	2.11	12.49	<0.01+	34.74	1.63	30.81	2.42		
Moss	2.19	0.33	1.76	0.33			1.97	0.27	2.28	0.52		
Stem Densities (no./ha)												
<2.5 cm	4939.86	573.57	6766.60	690.85	5.49	0.02+	5478.86	453.27	6222.43	1360.03		
>2.5-8 cm	658.02	53.40	823.24	80.34			672.79	46.25	909.93	125.68		
>8-23 cm	299.53	21.18	287.50	25.79			287.41	17.38	325.37	43.03		
>23-38 cm	93.63	4.69	84.57	5.17			91.36	3.74	85.66	9.52		
>38-53 cm	29.01	2.48	33.79	3.34			29.23	2.12	37.13	5.13		
>53-68 cm	9.79	1.40	7.23	1.23			9.10	1.08	7.72	2.49		
>68 cm	2.95	0.57	4.49	1.10			3.31	0.56	4.41	1.59		
Snags >2.5 cm	41.84	4.48	52.04	7.57			46.10	4.61	43.78	7.78		
Canopy Cover (%)												
0.5-3 m	52.62	2.09	47.54	2.89			50.40	1.89	51.91	4.01		
>3-6 m	60.99	2.01	57.66	2.99			59.41	1.91	61.03	3.64		
>6-12 m	65.97	1.25	61.91	2.51			64.41	1.31	64.56	3.35		
>12-18 m	62.52	2.22	56.45	2.43			59.39	1.95	63.60	3.13		
>18-24 m	48.23	2.96	45.20	3.29			46.95	2.52	47.65	4.75		
>24 m	15.26	2.09	20.55	2.46			16.82	1.73	18.97	4.23		
Structural Diversity Index	61.12	1.16	57.86	1.67			59.48	1.12	61.54	1.84		

Table 20. Means, standard errors (SE), and forward logistic regression results (Wald chi-square statistics) for the presence/absence of the Black-and-white Warbler and Scarlet Tanager at point counts in forested habitats in southwestern West Virginia. The '-' and '+' indicate either a negative or a positive relationship between abundance and the habitat variables.

	Black-and-white Warbler						Scarlet Tanager					
	Absent		Present				Absent		Present			
Variable	Mean	SE	Mean	SE	X^2	P	Mean	SE	Mean	SE	X^2	P
Aspect Code	1.04	0.08	1.05	0.12			1.10	0.09	0.98	0.11		
Slope (%)	32.56	2.16	35.57	2.01			30.77	1.99	37.30	2.25	8.45	<0.01+
Elevation (m)	370.14	10.18	372.12	13.03			356.13	10.31	388.38	11.99		
Distance to mine (m)	1022.10	158.37	858.70	170.12			696.48	140.22	1263.70	182.72	11.06	<0.01+
Distance to closest minor edge (m)	58.47	9.79	46.39	9.48			59.46	12.10	46.77	5.30		
Canopy Height (m)	21.89	0.63	22.26	0.78			21.62	0.70	22.53	0.67		
Ground Cover (%)												
Water	0.78	0.24	0.74	0.24	6.98	<0.01-	0.65	0.24	0.90	0.25		
Litter	50.47	1.69	51.36	2.13			50.00	1.76	51.79	2.00		
Bareground	8.41	0.69	6.29	0.76			7.42	0.63	7.72	0.87		
Woody Debris	4.90	0.41	4.23	0.41			4.43	0.39	4.87	0.45		
Green	34.44	1.66	33.24	2.47			35.11	1.62	32.60	2.37		
Moss	1.86	0.31	2.28	0.38			2.04	0.34	2.02	0.34		
Stem Densities (no./ha)												
<2.5 cm	5855.39	656.44	5285.85	551.49			5618.89	663.50	5637.82	601.06		
>2.5-8 cm	673.41	59.55	790.44	69.93			658.29	55.66	793.27	73.52		
>8-23 cm	270.22	15.70	332.17	32.60			289.81	23.09	301.12	23.13	3.92	0.05+
>23-38 cm	88.97	4.29	92.10	6.10			92.39	5.25	87.66	4.60		
>38-53 cm	28.80	2.28	33.82	3.61			31.93	2.66	29.49	3.04		
>53-68 cm	10.05	1.35	6.99	1.42			9.78	1.57	7.69	1.11		
>68 cm	2.57	0.59	4.96	1.01			3.94	0.79	3.04	0.76		
Snags >2.5 cm	47.85	5.77	42.49	5.14			41.21	4.79	50.66	6.54		
Canopy Cover (%)												
0.5-3 m	50.44	2.32	51.10	2.50			48.07	2.18	53.81	2.63		
>3-6 m	58.01	2.08	62.32	2.80			57.28	2.07	62.63	2.70		
>6-12 m	62.23	1.39	67.76	2.18			64.89	1.59	63.91	1.94		
>12-18 m	59.53	2.22	61.29	2.60			63.32	2.22	56.60	2.48		
>18-24 m	46.91	2.83	47.35	3.62			48.61	2.91	45.29	3.42		
>24 m	16.25	2.07	18.75	2.59			16.96	2.23	17.60	2.36		
Structural Diversity Index	58.68	1.18	61.71	1.63			59.83	1.23	59.97	1.54		